REMARKS

Claims 1-2, 4-37 and 39-46 are pending in the application. Claims 1-15 and 17-46 were rejected. Claim 16 is objected to as allowable if amended into independent form.

In the Office Action, Claims 1-2, 9, 20, 29, 44, and 46 were rejected pursuant to 35 U.S.C. §103(a) as being obvious over Roth (U.S. Patent No. 5,315,512) in view of Urbano et al. (U.S. Patent No. 5,976,088) or Hossack et al. (U.S. Patent No. 5,924,991), further in view of a) Urbano et al. (U.S. Patent No. 6,228,030) or alternatively Jackson et al. (U.S. Patent No. 6,673,017) and Olstad (U.S. Patent No. 6,447,450), or b) Hossack et al. (U.S. Patent No. 6,511,426) or Brouwer et al. (U.S. Patent No. 6,542,626). Claims 2 and 33-35 were rejected pursuant to 35 U.S.C. §103(a) as being unpatentable over Roth in view of Urbano et al. or Hossack '991, in view of the further references for claims 1 and 29, and in further view of Mo et al. (U.S. Patent No. 6,012,458). Claim 4 was rejected pursuant to 35 U.S.C. §103(a) as being unpatentable over Roth in view of Urbano et al. or Hossack '991, in view of the further references for claims 1 and 29, and in further view of Hoff et al. (U.S. Patent No. 6,315,730). Claims 5-8, 10-11, 21-28, 30, 36, 38, 40-43, and 45 were rejected pursuant to 35 U.S.C. §103(a) as being unpatentable over Roth in view of Urbano et al. or Hossack '991, in view of the further references for claims 1 and 29, and in further view of Ramamurthy et al. (U.S. Patent No. 5,846,202). Claim 12 was rejected pursuant to 35 U.S.C. §103(a) as being unpatentable over Roth in view of Urbano et al. or Hossack '991, in view of the further references for claims 1 and 29, and in further view of Ramamurthy et al. and Hoff et al. Claims 13 and 32 were rejected pursuant 35 U.S.C. §103(a) as being unpatentable over Roth in view of Urbano et al. or Hossack '991 , in view of the further references for claims 1 and 29, and further in view of Ramamurthy et al. and Holupka (U.S. Patent No. 5,810,007). Claims 14-15 and 17-19 were rejected pursuant to 35 U.S.C. §103(a) as being unpatentable over Roth, Urbano et al. or Hossack '991, in view of the further references for claims 1 and 29, and further in view of Greer et al. (U.S. Patent No. 5,959,622). Claim 31 was rejected pursuant to 35 U.S.C. §103(a) as being unpatentable over Roth in view of Urbano et al. or Hossack et al. , in view of the further references for claims 1 and 29, further in view of Ramamurthy et al., and further in view of Hossack et al. (U.S. Patent No. 6,042,545). Claim 37 was rejected pursuant to 35 U.S.C. §103(a) as being unpatentable over

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Roth in view of Urbano et al. or Hossack et al. , in view of the further references for claims 1 and 29, further in view of Ramamurthy et al., and further in view of Hoff et al.

Applicants respectfully request reconsideration of the rejections of claims 1-15 and 17-46, including independent claims 1, 21, and 29.

Independent claim 1 recites a processor operative to recognize one or more non-cyclical distinguished events and to select a portion of an ultrasound examination based on the recognition of the one or more distinguished events. The recognition of the one or more non-cyclical distinguished events is based on analysis by the event recognition processor of ultrasound image data sets of the ultrasound examination. Independent claim 1 was previously rejected pursuant to 35 U.S.C. §103(a) as being obvious over Roth in view of Urbano et al. or Hossack et al. Applicants noted that Roth, Urbano et al. and Hossack '991 fail to disclose a processor operable to recognize a non-cyclical distinguished event. The distinguished events of the cited references are silent about processor-based implementation and likely rely on manual activation (e.g., manual trigger prior and after contrast agent injection or manual scanning once the patient holds their breath). Roth, Urbano et al. and Hossack '991 also fail to disclose the recognition of distinguished events based on analysis by the event recognition processor of ultrasound image data sets. The cited references use ECG or breathing monitor information, not ultrasound image data sets. Pre verses post contrast agent or when holding breath criteria for selection are not indicated as performed by a processor and are not indicated as being based on analysis of ultrasound image data sets. There is no suggestion to recognize with a processor an event based on analysis of ultrasound image data sets.

In the current Office Action, the Examiner responds to the arguments above by noting that "inclusion of language relegating recognition of non-cyclic events by the recognition process(or) to image-based analysis yet leaves residual rejection issues associated with further technology which based frame selection by image data analysis on the non-cyclic nature of irregularities in the heart cycle, and with further technology which based frame selection for intermediate activities (compounding) or modes (zoom) based upon non-cyclic heartbeat sub-portion irregularities or upon non-cyclic movement/stationary thresholds derived from the image frame." In particular, the Examiner relies on further view to a) Urbano et al. '030 (U.S. Patent

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No. 6,228,030) or alternatively Jackson et al. (U.S. Patent No. 6,673,017) and Olstad (U.S. Patent No. 6,447,450), or b) Hossack et al. (U.S. Patent No. 6,511,426) or Brouwer et al. (U.S. Patent No. 6,542,626) for these teachings.

Please note that Urbano et al. '030 is the same disclosure as Urbano et al. '088. The rejection based on Urbano et al. '030 only involves two patents, unlike the other rejections of three or four patent combinations. Regardless of the number of patents in the various combinations, the subject matter of claim 1 would not have been obvious to a person of ordinary skill in the art.

For the more simple combination of Roth in view of Urbano '088 (Urbano '088 also teaching the cited sections of Urbano '030) or Roth in view of Hossack '991 in further view of Urbano '030, a person of ordinary skill in the art would not have used heart cycle variation image processing to recognize non-cyclical distinguished events of a subset of an examination to select a portion of the examination to be stored or marked. Urbano '030 merely changes the acquisition parameter (e.g., frame rate) in light of variation in the heart cycle (Urbano '030 at col. 9, lines 5-13 and Urbano '088 at col. 8, lines 56-64). However, the variation is cyclical – faster at some portions of the heart cycle and slower for other portions (Urbano '030 at col. 8, lines 42-53 and Urbano '088 at col. 8, lines 26-37). Urbano '030 does not suggest non-cyclical distinguished event recognition based on analysis of image data by a processor. The cited teachings of Urbano '030 control acquisition of data or the examination, not selecting a portion of an examination. For selecting a portion, Urbano '030, like Urbano '088, teaches reliance on the heart cycle timing signal for identifying an event. It is because the heart cycle may vary that heart cycle triggering is used. Based on the cited teachings of Urbano '030, a person of ordinary skill in the art would not have used heart cycle variation image processing to recognize non-cyclical distinguished events of a subset of an examination to select a portion of the examination to be stored or marked.

As noted by the Examiner, Jackson and Olstad are similar, so a person of ordinary skill in the art would not have used heart cycle variation image processing to recognize non-cyclical distinguished events of a subset of an examination to select a portion of the examination to be stored or marked. Jackson use tissue velocity from image data to determine the heart cycle (col. 6, lines 22-32). Waveforms for each cycle are determined (col. 6, lines 43-51). The waveforms

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are then compared and fit to each other (col. 6, lines 52-67). The fitting aligns the waveforms for temporally interleaving the data from different cycles into a representation of a single cycle (col. 7, lines 29-33 and col. 8, lines 9-22). Jackson does not suggest non-cyclical distinguished event recognition based on analysis of image data by a processor. The cited teachings of Jackson are for interleaving frames from different cycles into one cycle, not selecting a portion of an examination. It is the cyclical nature of the derived waveforms that allow for the fitting and accounting for variation in each cycle. Based on the cited teachings of Jackson, a person of ordinary skill in the art would not have used heart cycle variation image processing to recognize non-cyclical distinguished events of a subset of an examination to select a portion of the examination to be stored or marked.

Olstad combine image frames from a same phase of the heart cycle (col. 4, lines 37-46). Due to variation in the heart cycle, some phases are updated more frequently (col. 5, lines 1-10). The alignment in the heart cycle or phase for a particular frame is determined from an ECG trace and temporal indexing relative to an R-event of the ECG (col. 4, lines 12-18 and col. 5, lines 18-25). Olstad does not suggest non-cyclical distinguished event recognition based on analysis of image data by a processor. The cited teachings of Olstad are for combined frames from different cycles into one cycle, not selecting a portion of an examination. It is the cyclical nature of the derived waveforms that allow for the combining and accounting for variation in each cycle. Based on the cited teachings of Olstad, a person of ordinary skill in the art would not have used heart cycle variation image processing to recognize non-cyclical distinguished events of a subset of an examination to select a portion of the examination to be stored or marked.

Urbano '030, Jackson and Olstad teach variation in the heart cycle. However, the cyclical nature of the heart cycle is used to deal with the variation. Dealing with the variation does not suggest using non-cyclical distinguished events in place of the ECG triggers. A person of ordinary skill in the art would not have provided the limitations of claim 1 based on the teachings of Roth et al. in view of Hossack '991 or Urbano '088 based on Jackson, Olstad or Urbano '030.

The cited sections of Hossack '426 teach compounding elevationally spaced frames of data (col. 9, lines 41-49). The level of compounding is a function of the correlation between the frames of data (col. 11, lines 57-65). Hossack '426 determine correlation for each frame of data

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to vary the level of compounding. The cited teachings of Hossack '426 are for combining on-going frames, not selecting a portion of an examination by distinguishing a non-cyclical event. Image processing to correlate does not suggest use in distinguishing a non-cyclical event for selecting a portion of an examination, especially where the base references teachings are for ECG based cyclical event triggering. Based on the cited teachings of Hossack '426, a person of ordinary skill in the art would not have used correlation image processing to recognize non-cyclical distinguished events of a subset of an examination to select a portion of the examination to be stored or marked.

The cited sections of Brouwer et al. teach generating a histogram for each image frame (col. 4, lines 7-11). By comparing the histograms, the processor determines whether to re-optimize imaging parameters (col. 4, lines 20-28). One example is using the histograms to determine a lack of motion of the transducer and reset transmit parameters to zoom (col. 7, lines 52-65). Brouwer et al. determine similarity between each image frame to set imaging parameters for subsequent image frames, so do not suggest selecting a portion of an examination for storage or marking based on the distinguished event. The other cited art deals with ECG based cyclical event triggering. There is no suggestion that the teaching of Brouwer et al. would have been used instead of ECG based cyclical event triggering. It is the cyclical nature of the events that lead the other cited art to select portions of the examination for storage or marking. Brouwer et al. seek to vary imaging on an ongoing basis, not select portions of an examination. The implementation taught by Brouwer would be confused by cyclic variations and would continuously indicate that there is motion when looking at the heart. Brouwer's method of change detection as an input could not simply be used for selecting portions of an examination to be stored or marked because of the cyclic variation problem. The cyclic variations would swamp out the non-cyclical distinguishing events with Brouwer's detector and teachings. Based on the cited teachings of Brouwer et al., a person of ordinary skill in the art would not have used on-going image processing to set imaging parameter in order to also recognize non-cyclical distinguished events of a subset of an examination to select a portion of the examination to be stored or marked.

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Similar to claim 1, claim 29 recites inputting data to an event recognition processor and processing whether a non-cyclical distinguished event has occurred, and if one has occurred, selecting a subset of the image data sets. As discussed above for claim 1, these limitations would not have been obvious to a person of ordinary skill in the art in light of these teachings.

Independent claim 21 recites automatically recognizing from image analysis and marking or storing non-repeating subsets of an examination where the one or more non-repeating subsets are bracketed by one or more pairs of distinguished events determined as a function of the image analysis. As discussed above for claims 1 and 29, these limitations would not have been obvious to a person of ordinary skill in the art in light of these teachings.

Ramamurthy et al. use repeating triggers determined from EKG, phonocardiogram, pressure wave, pulse wave, respiratory signal, pulse wave or continuous wave Doppler, m-mode strip display, or physio recording devices (col. 13, lines 45-56). While pulse wave or continuous wave Doppler information or m-mode strip display information may be ultrasound image data, Ramamurthy et al. do not indicate how the Doppler or m-mode information is used for triggering or whether the information is part of the examination for marking or storing. Ramamurthy et al. do not disclose recognizing from image analysis or distinguished events determined as a function of the image analysis of the ultrasound examination.

Applicants respectfully submit that a person of ordinary skill in the art would not have used the teachings of Ramamurthy et al. with Roth. Roth collects a fully sampled set of data for later decimation or gating to identify the desired fames (Col. 9, lines 5-16). Roth specifically teaches retrospective selection as desired (Col. 6, lines 34-36; Col. 7, lines 31-37; and Col. 9, line 11-16). Conversely, Ramamurthy et al. trigger acquisition so that data is only acquired at certain times (Col. 6, lines 1-7; Col. 6, lines 42-56) or so that a parameter is varied at different times (Col. 8, lines 47-62). Ramamurthy et al. trigger during acquisition to improve cardiac function detection (Col. 2, lines 35-40), so teach corresponding proccsses. Roth instead teaches retrospective gating or selection. A person of ordinary skill in the art would not have used the acquisition based triggering and associated teaching of Ramamurthy et al. with the systems and method of Roth adopted to select from or gate a fully sampled previously acquired examination.

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Dependent claims 2, 4-20, 22-28, 30-37, and 39-46 depend from the independent claims 1, 21, and 29 discussed above, and are thus allowable for at least the same reasons as the corresponding independent claim. Further limitations distinguish over the reference or references used to reject the dependent claims.

For example, claim 2 has been previously amended in the Office Action Response and Amendment of February 22, 2005 to correct antecedent basis. The Examiner premises the rejection on a lack of antecedent basis and manual operation in Roth. Roth, Urbano et al. and Hossack '991 do not disclose recognition by a processor of a stationary probe by analyzing image data sets.

In recognition of the disclosure of Roth for claim 2, the Examiner rejected claims 2 and 33-35 over the further reference of Mo et al. Claims 2 and 33-35 recite a distinguished event based on an absence of motion. Mo et al. discard interpolated frames (Col. 5, lines 35-55). Motion is not used to distinguish an event based on analysis of image data sets. Additionally, Mo et al. also do not suggest reviewing motion in an image to identify an event as claimed in claim 35.

Claims 4, 12, and 37 recite determining a distinguished event based on a rate of change of brightness. Hoff et al. was cited for this disclosure. Hoff et al. disclose deriving wash-in curves from second harmonic intensities (Col. 7 lines 20-24). A plot showing a rapid rise in backscatter may be generated (Col. 8, lines 14-18). Hoff et al. merely plot a curve, but do not suggest determining an event based on a rate change. The Examiner relies on the motivation of associating the wash-in curve with ECG triggering to identify hypo-perfused cardiac tissue. Roth, Urbano et al. and Hossack '991 do not teach processor based image data set analysis for a distinguished event. Hoff et al. plot a wash-in or out curve. There is not teaching or suggestion to use wash-in by a processor as a distinguished event. In addition, a person of ordinary skill in the art would not have used the trigger-based acquisition of Hoff et al. (Col. 7, line 17) with the full acquisition and later gating of Roth for the reasons discussed above regarding Ramamurthy et al.

Claim 5 recites recognizing a jet in color Doppler as an event. Ramamurthy et al. use color Doppler imaging, but do not show a processor to recognize a jet. The highest velocity

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mapping alone does not identify a jet event, but only results in an image of the highest velocities where the highest velocities may or may not be associated with a jet.

Claim 39 recites an event based on a rate of change of velocities. Ramamurthy et al. identify a highest velocity, but not a rate of change.

Claims 13 recites a cropping factor based upon characterization of an image. Holupka et al. crop automatically or manually with a special mask (Col. 6, lines 19-28). Holupka et al. do not suggest a cropping factor or a cropping factor based on characterization of an image.

Regarding claims 14-15 and 17-19, applicants respectfully submit that a person of ordinary skill in the art would not have used the feedback of Greer et al. in the system of Roth. Roth identifies images after an exam, and thus does not need the feedback. Roth also generally identifies one image every heart cycle or few heart cycles. The feedback of Greer et al. would be provided at the same frequency. Such frequent feedback, such as beeps or visual flashes, would be distracting and undesired in a medical environment absent an emergency. A person of ordinary skill in the art would not have used the feedback of Greer et al. with Roth.

Claim 31 recites selecting a subset of image data sets with decimation. Hossack '545 decimates within a given image (Col. 7 lines 56-58), not decimation of image data sets.

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CONCLUSION

Applicants respectfully submit that all of the pending claims are in condition for allowance and seeks early allowance thereof. If for any reason, the Examiner is unable to allow the application but believes that an interview would be helpful to resolve any issues, he is respectfully requested to call the undersigned at (650) 943-7554 or Craig Summerfield at (312) 321-4726.

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